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ABSTRACT

This paper proposes that a study be done in the area of diffusion of innovations using a recently developed communication methodological tool, metric multidimensional scaling (MDS). An argument is made for using MDS to measure cultural concepts which are shared by members of a society. A definition of homophily-heterophily is presented as the canonical correlation between the spaces of two different social systems. The proposition is presented that as two societies interact and communicate they will become more homophilus over time. (RB)

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SOCIAL SYSTEM HOMOPHILY AS A FUNCTION OF COMMUNICATION

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CS 500 839

Social System Homophily as a Function of Communication

Although communication has been defined as a process, there has been little research which has adopted a process orientation. This is especially true in the area of cross-cultural communication and a major component, the study of how innovations diffuse from industrial to nonindustrial societies. The reason for this lies not at the theoretical level, rather, it persists because of the lack of adequate funding and the use of methodological tools borrowed from non-process orientated disciplines, e.g., Psychology or Sociology.

This paper proposes a study in the area of diffusion of innovations using a recently developed communication methological tool, metric multi-dimensional scaling (MDS). An argument will be made for using MDS to measure cultural concepts which are shared by members of a society. The meaning of any set of concepts at any point in time can be represented by a matrix reducible by MDS to locations on a set of spacial coordinates. In order to look at the process of communication, MDS spaces are generated at equal time intervals and the changes in the locations of the concepts are measured. A definition of homophily-heterophily is presented as the canonical correlation between the spaces of two different social systems. A proposition is presented, that as two societies intercommunicate, they will become more homophilus over time.

Prior to the diffusion of an innovation a society holds a fairly stable set of conceptions with regards to the practices that the new product or idea is meant to alter. The source society from which the innovation comes and the receiving society to which it is diffused are often quite heterophilus regarding that object. During the diffusion process the cultural definition

of the innovation changes rapidly until the definition of the object held by the receiver society becomes more similar to the source system.

Finally, an example set of data will be presented to suggest the feasibility of the proposed methods to cross-cultural settings.

Theory-Measurement

The definition of any concept may be taken to be that term's relationship to all the other concepts (words) which are used to differentiate that referent as a unique object (Fillenbaum and Rapoport, 1971). "Fundamentally this involves taking note of similarities and differences between objects, and differentiating the attributes of the object from those attributes of the objects which are different" (Woelfel, 1972:4-5). Woelfel states further, (4-11)

> Dissimilarities among objects (whatever those objects may be) may be represented by a continuous numbering system such that two objects considered to be completely identical are assigned a pair dissimilarity score or a distance score of zero (0), and objects of increasing dissimilarity are presented by numbers of increasing value. Assuming that the definition of an object or concept is constituted by the pattern of its relationships to other objects, the definition of any object may be represented by a 1 x N vector where d_{11} represents the distance or dissimilarity of object 1 from itself (thus $d_{11} = 0$ by definition), d_{12} represents the distance dissimilarity between objects one and two, and d_{1n} represents the distance between the first and the Nth object. Similarly, the second object may be represented by the second vector d_{21}, d_{22}, d_{23}, ... d_{2n} and the definition of any set of concepts of objects may therefore be represented in terms of the matrix D, where any entry d_{ij} represents the dissimilarity or distance i and j.

The distance matrix, D, provides a static picture of the interrelationships among a set of objects at any one point in time possessed by a single individual. Process can be recorded in successive matrices D_{t0}, D_{t1}, D_{ti} ...,

D_{tn} where the intervals between time periods 0, 1, 2, ... n, remains constant or are known, and the changes between the matrices calculated. These intervals can be made as small as desired to increase the isomorphism with the continuous nature of the notion of process. Since this paper is concerned with social systems rather than with single individuals the matrices must be generated for an entire culture. The cultural definitions of a population may be represented as the average distance matrix $\bar{D}$, where any entry $\bar{d}_{ij}$ is the arithmatic mean conception of the distances d_{ij} of the members of the society.*

What has emerged is a cultural definition of a set of concepts, in matrix format, dynamic in the sense that successive matrices can be generated to measure change over time. While this matrix is an accurate representation of a set of objects, it is extremely cumbersome due to its size. The matrix is of order n, where n equals the number of concepts. N-1 is the maximum total number of dimensions used by the sum of the individuals of a society to differentiate the objects, not the ones shared by the members of the social system. This matrix may be reduced to usable proportions and the uniquely shared underlying cultural dimensions identified. This task can be performed by multidimensional scaling. According to Helm, Messick and Tucker (1959:14),

> The fundamental concept in multidimensional scaling is psychological distance, which is usually estimated in terms of judgments of similarity among stimuli; i.e., two stimuli judged to be very similar are considered to be psychologically closer together than two stimuli judged to be very different. Given judgments of similarity among all the stimuli in a set, mathematical models exist which provide an interpretation of these psychological distance in terms of Euclidean geometry. The stimuli are treated

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*For an excellent discussion of the bias of the social science concerning their focus on the individual as the unit of analysis rather than on other units of focus see Coleman, 1958 and Rogers and Bhowmik, 1971.

> as points in a Euclidean space and analytical techniques are available to obtain the dimensionality of the space as well as stimulus scale values determined within a rotation and translation.

Multidimensional scaling models can be used in situations where the stimuli may vary simultaneously with respect to several underlying dimensions or attributes. According to Warren G. Torgerson (1958:248),

> The notion of a single unidimensional, underlying continuum is replaced by the notion of an underlying multidimensional space. Instead of considering the stimuli to be represented by points along a single dimension, the stimuli are represented by points in a space of several dimensions. Instead of assigning a single number (scale value) to represent the position of the point along the dimension, as many numbers are assigned to each stimulus as there are independent dimensions in the relevant multidimensional space. Each number corresponds to the projections (scale value) of the points on one of the axes (dimensions) of the space.

The process is analogous to converting a matrix of city to city milages to a graphic representation such as the map itself. In this special case, an n x n table of n cities may be reduced to a 2 dimensional plot. The mathematical operations necessary to perform multidimensional scaling can be found in Torgerson (1958), Chapter 11.

Several attributes are unidimensional, among them; weight and length. Spacial position, however, varies along three dimensions, height, length and width. Location on the surface of the earth is also measured with three dimensions: altitude, longitude, and latitude. Knowledge of the position of an object along any one or two dimensions will not locate it precisely in the space. All three dimensions must be known. Likewise, color is said to possess several underlying qualities. The color green can vary simultaneously according to hue, chroma and any other of several different qualities. Woelfel (1972) suggests that a limited number of underlying dimensions can be applied to all cultural concepts.

MDS has been used in the past to investigate the dimensions underlying personality (Jackson and Solley, 1957; Messick, 1961), political concepts (Klingburg, 1941; Wish, 1970), the meaning of lexical items (Cliff, Pennell and Young, 1966; Henley, 1969; George A. Miller, 1969; Fillenbaum and Rapoport, 1971), and the perception of speech sounds (Miller and Nicely, 1955; Degerman, 1972).*

After a set of spacial coordinates has been generated at each separate point in time, they can be rotated to a least-squares best fit congruence in order to calculate the change in position over time. With this information, it becomes possible to discuss the velocities at which the concepts are moving in space as the result of information which enters the social system. Also possible is the calculation of change in velocity over time, acceleration, a necessary component of process (Arundale, 1971, 1973).

Theory-Diffusion

Homophily, as defined by Rogers and Shoemaker (1971:14), "is the degree to which pairs of individuals who interact are similar in certain attributes, such as beliefs, values, education, social status and the like." Heterophily is the opposite--the degree to which interacting pairs are different in certain attributes. The terms are not mutually exclusive categories but rather bipolars on a single scale. It becomes useful "to speak of 'degrees of homophily,' as measured by indices of positive correlation between the attributes f friends, or of 'degrees of heterophily' as measured by indices of negative correlation" (Merton and Lazarsfeld, 1954:17).

In the seminal article which defined the construct, Merton and Lazarsfeld noted that amount of interaction and degree of heterophily may be

*This research was all performed with nonmetric MDS, i.e., they scaled ordinal data. Because the data was scaled at this level, the metric was violated and comparisen over time rendered impossible.

reversible or mutually causal. That is, having similar beliefs may lead people to increased interaction and/or communication may lead to increased similarity among the interactants.* This problem of reversibility can somewhat be resolved by dynamic observation. ". . . little enough is known about the dynamic processes that give rise to the observed patterns of an over-representation of friends among those with common values, and an under-representation among those with discordant values" (Merton and Lazarsfeld:29). Traditionally, the construct has been measured at only one point in time. The author failed to find any study where change in degree of homophily was measured. This has perhaps given rise to the notion that effective communication is the result of pairs being homophilous rather than the reverse.

There is a large body of empirical evidence which suggests that similarity of attitudes is a significant determinant of attraction to friends and spouse, but these findings are based on static measures. They are reviewed in Byrne (1969). Of notable exception is Theodore Newcomb's, The Acquaintance Process, (1961), which studied changes in interpersonal attraction as related to attitudes and other variables such as: proximity, social structural variables and imbeddedness in social networks. He concluded that similarity of attitudes was ". . . of sufficient importance to our subjects to influence their attraction toward others . . ." (254).

There have been many studies that have dealt with the above proposition in a cross-cultural setting. Bose (1962) looked at homophily based on caste ranking, education and size of farms in traditional India and income is "modern"

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*This proposition was presented in terms of value-homophily, not in regards to objective measures of homophily such as age, sex, race, or social status.

Calcutta and the relation of these variables to communication about innovations. Dasgupta (1968) found in Uttar Pradesh, India that the presence of a stratification system in terms of caste retarded communication. Chou (1966) examined homophily in Columbia and found little relationship between homophily based on competence and social structure and degree of interaction. Patel (1966) investigated the relationship between social status and competence and the diffusion of innovations. Liu and Duff (1972) concluded that heterophilous relationships may be necessary for effective diffusion of new ideas. Others concerned with this subject area are enumerated in Rogers and Shoemaker (1971: 376-378).

In almost all of these studies, the individual has been the unit of analysis. Chou (1966) and Patel (1966) looked at dyads rather than single subjects. Of notable exception is a thesis by Yung Chang Ho (1969) which looked at <u>within</u> system homophily in twenty Brazilian communities and failed to find a single significant relationship between rate of community economic development and homophily as measured by opinionatedness, literacy, mass media exposure, cosmopoliteness and other objective variables.

This paper proposes to look at changes in <u>between</u> system homophily as a function of the communication between social systems. That is, how similar are two different social systems? Does communication between them make the two systems more similar? And, how does information sent between two systems alter the rate of change in the process of becoming more homophilous?

Homophily-heterophily between social systems may be seen in terms of the culture of the social system. How similar are the cultures of two different societies and how do they change as a function of intercommunication? This notion can be clarified by the example of language--a shared cultural object.

When the Normans invaded England in 1066, they brought the French language with them. Over the next two hundred years, the English culture incorporated many French words such as, beef, veal and pork, into their language. Before them only the words cow, calf and swine existed for these objects. In a sense, these French words were diffused into the English society. The two cultures thus became more similar because they shared a common symbol for the same referent. Hence, a change in homophily was a result of the communication between the members (components) of the different social systems.

The utility of looking at social system change rather than modifications in individuals becomes obvious when dealing with problems at a systems level. Population control would be a good example. It is necessary to alter the shared cultural definitions about such concepts as birth control, abortion, vasectomy, the pill, diaphram and I.U.D. If only a small group of individuals' attitudes are altered, the population will continue to grow in the other segments of the population and the situation will not be ameliorated. Added to this, is the problem of being labeled deviant by the other members of the society for practicing an innovative behavior. Also there may exist a problem of restricted supply of products necessary to perform these activities. Thus, the focus should be at the cultural level, rather than with the individual.

Social system homophily-heterophily, may be defined as the extent to which cultural conceptions (definitions) are similar between two different societies. In terms of MDS, it is the degree of congruence between two different spaces generated on the same concepts by two separate groups of people. Operationally, this may be taken to be the correlation between the two aggregate MDS spaces. Because it is necessary to simultaneously compare locations on all of the underlying cultural dimensions, canonical correlation

must be used. If two social systems were perfectly homophilous, then they would use the same cultural dimensions to define the objects and the concept's location on each of these axis would be the same. Hence, the canonical correlation for each separate dimension would be 1.0. As the systems become heterophilous, the coefficients will decrease in size. There is no theoretical minimum of the correlation, however, if the two systems were perfectly heterophilous then there would be no shared meaning and therefore communication between the societies would be impossible.

Methodology

The methodology to be used to test the hypothesis, as two social systems interact they will tend to become more homophilous in regards to the subject matter communicated, is as follows: Generate MDS spaces for three social systems at six or more equal intervals in time; three points prior to the manipulation, at least one during and two after. The reason for the large number of observations is to gain data on the variation of the rate of change over time (acceleration). This may be positive or negative. In order to gain information about acceleration three points are the necessary minimum. These must be gained prior to the manipulation in order to determine the "natural" acceleration of the system. At least one measurement would be taken during the manipulation. Additional data points may be collected during the diffusion campaign in order to determine the shape of the adoption curve. Two measurements should be made after the manipulation to observe the change in the rate due to the alterations of the society. These rates of change can be found by determining the change in the slopes (derivatives) between each measurement point.

Ordinarily, only four measurements are sufficient to determine changes in acceleration. However, when dealing with long term effects, as with the diffusion of innovations, additional measures become necessary. Are the people adopting the innovation or are they only going through a trial period? Is there permanent cultural change occurring or only short-term alterations in the cultural definitions? Another advantage of having at least two readings after the manipulation is to control for the effects of maturation. Was the system change caused by the manipulation or was it produced by some other factors at the identical time (Campbell and Stanley, 1963: 37-42)?

The three social systems from which data would be gathered are: (1) a source system, from which the innovation originated; (2) a receiver system, where the experimental manipulation, a diffusion campaign, would take place; and (3) would be a control system which should be culturally homophilous at time 1 to the receiver system. No diffusion campaign would take place in this system.

Data would be gathered from separate random samples* at each point in time so as to avoid sensitization, a potentially destructive problem with such a large number of measurements. However, since the unit of analysis proposed is not the individual but the culture of the respective social system, it makes little sense to use the same subjects in light of sensitivity and mortality.

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*Barnett (1972) has shown that reliability of metric MDS increses as a function of sample size. The reason for this is that because of the law of large numbers, the mean values of the distance estimates become increasingly stable as sample size increases. Therefore, the space becomes very consistent. Thus, reliable measurement becomes only a function of the cost of gathering additional cases.

The spaces would be generated by having the subjects perform distance estimates on pairs of concepts which are of interest. For example, if population control were the subject matter, then estimates could be made between the following concepts: birth control, abortion, vasectomy, BCP, diaphram, IUD, making love, security and other related notions. This is performed by saying if X and Y are some arbitrary U units apart, how far apart are A and B? A and B are the concepts of interest. This is done until the entire matrix is generated. While this may seem very unreliable, Barnett (1972) and Gillham (1972) have shown that the format is extremely reliable on large samples in the United States and does not have the effect of biasing the responses.

The symbols used to create the distance matrices would be in the native language of the society under observation. This raises a potential problem of accurate translation of the words between the various languages. This is a common pitfall in cross-cultural research. This problem may be compounded when applied to a diffusion situation because a symbol for the innovation may not yet exist prior to its introduction to that society. Thus, the researcher must be careful in both the selection of concepts to study and their translation.

The experimental manipulation could be a standard diffusion campaign using change agents, radio forums, radio alone, other forms of mass media (newspapers, leaflets, wall posters) and other forms of interpersonal communications such as mobile loudspeakers or town meetings. This would go on for the designated time period with messages originating in the source society and transmitted by its members.

After all cultural conceptual spaces have been generated, they would be rotated to congruence and canonical correlations would be calculated

between them.* The hypothesis is that the spaces of the source system and the receiver system should become more congruent and therefore the size of the canonical correlations between them should increase, to approach 1.0. The initially high coefficient between source and the control system should remain stable prior to the manipulation, while the later spaces of these systems should become less congruent and the coefficients smaller.

A problem arises in that the source system is going through the process of modifying its cultural definitions throughout the study period. New technology may be developed, information from some specific component or information from a different society could alter the cultural conceptions of the source system. Thus, while the source and receiver systems may become more homophilous a necessary time lag may exist. This may be due to the time necessary for the message to be sent from one system to the other and the variable rates of social change of each society. Thus, the maximum canonicals may not be between the two final measurements. It may be between the final measurement of the receiver system and some prior reading of the source system. Thus, the ultimate dependent variable may become the rate at which convergence takes place rather than the canonical correlation for any one point in time.

It is also possible to observe change of the individual concepts in the space in order to determine how effective the diffusion campaign was at altering that term's definition or its rate of change. For example, if the goal of a diffusion campaign were to promote the use of vasectomies, then one

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*The computer software necessary to perform these operations is available at Michigan State University. It is known as Galileo Version II (Serota, 1974).

would be interested in the movement of that concept in relation to the others in the space.

While there has not yet been a prediction about the change of the rates of acceleration, it seems clear that there should be a modification in this rate during the manipulation in the receiver system. The slopes of the velocity of changes over time should resemble the diffusion curve Everett M. Rogers presents throughout his writings. When only the early innovators are adopting the object the slope should be small and positive. It should increase as the early majority adopt and then reach a peak. As the late majority start to adopt the innovation it becomes negative. Eventually the slope should approach zero as the laggards change their conceptions about the innovation. The control system's rate of change should remain constant throughout all the measurements. What happens after the diffusion campaign is unclear. This gives further justification for extra measurements. Will the system decelerate or will it continue at the same rate to modify its cultural conceptions?

Example

The author, along with Martin Mistretta and William Miles, collected an example of a set of data at the University of Illinois (Urbana) during the spring of 1972. It dealt with students' definitions of social problems. The researchers had intended to measure the effect of "Earth Week" by observing the movement of 15 scaled concepts at three points in time. The measurements were intended to occur once prior to earth week, one measurement during the week and one after the event. Specifically, the study was designed to predict the movement in the space as a function of mass media and interpersonal information that the student received about environmental topics.

Distance estimates were on the 105 pairs generated from the 15 following concepts, presented to the subjects in random order. A copy of a portion of the questionnaire is located at the rear of the paper.

1. Overpopulation
2. The War in Viet Nam
3. Public Transportation
4. Capitalism
5. The Most Serious National Problem
6. Automobiles
7. Air Pollution
8. Socialism
9. Noise Pollution
10. Environmental Protection
11. Pesticides
12. Crime
13. Water Pollution
14. Conservation
15. Recycling Resources

The sample consisted of 110 students enrolled in an introductory Sociology class. There were 61 matched cases, subjects who completed the questionnaire for all three administrations. The sample consisted of 31 males and 30 females. Their mean age was 18.8 years and they had completed on an average of 0.85 years of college. Their self perception of their political identification was 2.90 on a five-point scale where one represented radical right and five was left-revolutionary. Clearly, they were moderates.

Data were gathered on April 14, April 28, and May 19, 1972. Due to the impact of unanticipated social events, the results can be discussed only serendipitously.

On April 16, the Defense Department announced the bombing of Haiphong, North Viet Nam and the mining of that city's harbor. On April 19, the University of Illinois was besieged with heavy rioting in protest of the government's bellicose policies. The windows of the stores in the adjacent business district were broken and there was considerable looting. This continued for a number of days, despite the presence of the state police. The planned environmental programs were suspended or ignored. Between the second and the third data points, Governor George C. Wallace was shot while

campaigning in Maryland (May 15). Thus, there was a great deal of information made available to the subjects about certain concepts, that were scaled in the space. They were the War in Viet Nam, Crime and the Most Serious National Problem. Additional information about these topics was made available in open educational forums and leaflets which discussed the issues. There was little information concerning the majority of the ecological topics. This may be compounded by the fact that the majority of the subjects were college freshmen experiencing a campus upheaval and its informational bi-products for the first time.

Results

The mean distance matrices for each point in time are presented in Tables 1, 2 and 3. The spacial coordinates matrices for each point in time are presented in Tables 4, 5 and 6. A three dimensional solution was found in each case. These three coordinate systems were then rotated to a least-square best fit congruence and then the graphic representations (Figures 1, 2 and 3) plotted. The correlations between the axes over time are presented in Table 7. This is an indication of the quality of the solution. Finally, all three spaces were graphed together to produce a plot of the concepts' trajectories over time.

In regard to the movement of the key concepts, the war in Viet Nam moved 6.78 units between the first two measures, while crime moved 4.86 and the Most Serious National Problem (MSNP) 5.71, as compared to the mean movement of all concepts, 4.18 units. Between the second and the third measures, the war moved 11.05 units, crime 7.69 and MSNP, 6.87. The mean was 5.22 units. These concepts moved to a greater extent than the

environmental terms scaled in the same space. They were redefined to a greater degree than the environmental terms. Perhaps, this was due to the additional information the subjects received about these concepts.

The extent of redefinition becomes more profound when examining the plot of the concepts' trajectories. Both the war and crime moved in the direction of the Most Serious National Problem. The war seemed to be lagging behind the MSNP. The war's time two location is near the point of the time one definition of MSNP. The time three location of the war approaches the position of the time two definition of MSNP. Crime follows a similar pattern of movement. While there is movement of the other terms, it is difficult to assign direction to them. They do appear to move toward the original time one position between time two and three.

These findings clearly lack the rigor necessary to test the hypothesis that movement in the space is a function of the amount of information the subjects receive. This finding is only implied by the results. In order to test that hypothesis, one would need to control the information concerning the scaled concepts or perform a content analysis about those topics.

Summary

These data were intended only as an example of the use of metric multi-dimensional scaling. The diffusion process can be measured in a similar way using terms which reflect the innovation and related topics. This paper was written to suggest the use of the most recent developments in communication research methodologies for one specific aspect of the communication process.

In summary, this paper has presented the theory of multi-dimensional scaling and its application to intercultural communication, specifically the

area of diffusion of innovations. It has suggested the general proposition that as social systems intercommunicate, they would become more homophilous and outlined the methods necessary to test that hypothesis. This paper looked at the process of communication. Data might be gathered at many points in time making possible the observation of change of rate of change over time, a necessary condition for the study of process. The focus of this proposal has been on change of definitions along cultural dimensions of social systems rather than on individuals. Random representatives of the system are chosen, their estimates aggregated and then reduced into cultural dimensions. It is the changes of conceptions along these cultural dimensions that are compared to other systems rather than the specific members of these systems. Finally, the paper presented an example set of data to provide some indication of the feasibility of the methodology to communication research.

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MEANS DISTANCE MATRIX
TIME 1 - APRIL 14, 1972

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	0.0														
2.	24.2	0.0													
3.	11.6	35.3	0.0												
4.	29.5	7.4	15.4	0.0											
5.	8.4	5.7	26.0	10.4	0.0										
6.	10.2	26.7	3.1	9.0	16.0	0.0									
7.	5.3	19.2	3.6	12.6	8.3	2.8	0.0								
8.	16.4	11.8	14.2	15.0	16.3	15.2	16.5	0.0							
9.	7.0	27.7	5.0	16.8	13.7	5.4	7.4	18.4	0.0						
10.	7.9	21.8	5.8	29.6	9.4	9.7	6.4	14.6	10.5	0.0					
11.	11.3	25.7	18.6	16.7	14.9	19.9	13.5	18.6	15.7	6.7	0.0				
12.	6.2	16.7	15.5	10.0	6.7	14.9	34.4	14.0	19.5	14.6	27.8	0.0			
13.	5.7	25.4	14.3	12.1	8.8	17.0	3.4	25.6	8.7	6.1	6.0	25.1	0.0		
14.	14.9	24.4	10.7	21.9	25.5	27.0	8.0	16.4	11.5	3.8	8.8	24.3	8.7	0.0	
15.	9.1	24.0	15.7	23.5	11.6	19.7	9.3	17.3	12.1	4.9	11.5	25.8	8.9	3.9	0.0

18

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MEANS DISTANCE MATRIX
TIME 2 - APRIL 28, 1972

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	0.0														
2.	15.3	0.0													
3.	10.2	20.6	0.0												
4.	12.0	9.7	14.5	0.0											
5.	9.1	6.4	18.1	13.5	0.0										
6.	9.6	20.0	3.7	10.9	16.6	0.0									
7.	7.2	15.2	6.6	11.6	9.3	3.1	0.0								
8.	12.3	12.8	14.0	16.9	11.7	15.9	17.5	0.0							
9.	10.2	17.7	6.5	15.4	13.9	5.6	5.5	19.5	0.0						
10.	10.5	16.7	8.7	16.3	8.6	10.5	6.1	15.7	8.4	0.0					
11.	14.3	19.9	17.7	15.9	12.2	18.6	5.5	18.9	12.2	6.9	0.0				
12.	8.4	12.8	14.3	13.5	6.7	14.0	13.3	14.5	16.5	13.8	17.4	0.0			
13.	7.6	17.7	12.8	13.7	7.6	12.7	4.4	17.8	7.9	6.5	6.1	15.0	0.0		
14.	11.9	16.6	13.4	16.2	10.9	11.3	9.4	15.1	10.5	3.5	10.7	18.4	8.5	0.0	
15.	8.9	18.5	13.2	16.6	10.5	12.9	8.2	14.5	12.1	4.3	16.7	17.8	9.0	3.5	0.0

19

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MEANS DISTANCE MATRIX
TIME 3 - MAY 19, 1973

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	0.0														
2.	13.9	0.0													
3.	9.9	34.7	0.0												
4.	15.6	8.8	23.3	0.0											
5.	19.9	4.1	33.9	12.4	0.0										
6.	9.4	35.8	4.0	8.6	24.4	0.0									
7.	6.1	24.2	6.4	11.8	9.8	4.3	0.0								
8.	14.9	32.0	11.7	12.9	25.5	16.1	16.3	0.0							
9.	7.6	27.9	6.6	13.8	22.4	5.4	7.2	26.8	0.0						
10.	8.1	15.0	8.0	14.9	10.7	9.7	17.6	25.2	8.5	0.0					
11.	10.8	17.4	14.4	14.4	16.6	25.7	5.0	27.7	10.8	8.6	0.0				
12.	8.9	23.8	23.7	10.8	17.5	15.2	15.0	17.5	16.0	16.9	17.2	0.0			
13.	7.3	25.8	15.5	11.4	8.2	12.6	4.2	19.6	6.5	8.7	5.8	15.5	0.0		
14.	7.8	16.2	13.1	14.5	9.1	14.6	8.1	18.1	10.2	3.6	9.3	27.8	9.2	0.0	
15.	8.5	16.1	14.2	17.2	10.1	14.9	9.3	25.3	12.5	3.9	11.0	17.7	9.7	3.5	0.0

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SPACIAL COORDINATES
TIME 1 - APRIL 14, 1972

CONCEPT #	DIMENSION I	II	III
1	4.43	- 3.95	4.55
2	-18.49	11.31	2.77
3	9.04	-12.13	- 5.31
4	-12.04	0.94	-14.55
5	- 8.78	4.60	3.18
6	- 0.97	- 9.95	- 6.62
7	7.16	7.25	- 7.52
8	- 7.10	- 1.88	1.50
9	5.64	- 4.47	- 2.70
10	6.15	- 1.17	9.00
11	6.25	6.62	- 0.19
12	-14.24	-12.91	7.25
13	6.89	4.85	- 2.81
14	9.08	5.14	2.50
15	6.99	5.75	4.36

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SPACIAL COORDINATES
TIME 2 - APRIL 28, 1972

CONCEPT #	DIMENSION I	II	III
1	1.04	2.10	0.72
2	12.59	2.14	-2.02
3	- 4.50	-8.90	2.39
4	5.42	-3.59	-6.52
5	6.02	6.14	-0.32
6	-3.89	-9.08	-0.13
7	-3.88	-0.50	-3.55
8	7.81	-1.41	9.75
9	-6.16	-2.68	-2.92
10	-4.47	2.82	1.78
11	-4.92	8.39	-3.17
12	7.68	-2.85	-2.11
13	-4.09	3.77	-2.68
14	-4.23	3.84	3.88
15	-4.42	3.96	4.90

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SPACIAL COORDINATES
TIME 3 - MAY 19, 1972

	DIMENSION		
	I	II	III
CONCEPT #			
1	-1.25	0.62	0.14
2	10.70	-1.59	2.85
3	-1.74	5.16	-7.03
4	5.03	2.07	0.85
5	3.61	-3.12	5.15
6	-0.45	6.88	-5.51
7	-3.81	8.95	5.94
8	5.40	-0.78	-4.16
9	-3.11	2.25	-2.66
10	-1.42	-9.70	-6.60
11	-6.32	-2.80	4.90
12	7.01	0.72	1.69
13	-4.92	-0.63	3.45
14	-4.56	-3.89	0.65
15	-4.19	-4.63	0.34

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TABLE 7

CORRELATION BETWEEN THE N MENSIONS

		Time 1			Time 2			Time 3		
		1	2	3	1	2	3	1	2	3
	1	1.0								
Time	2		1.0							
1	3			1.0						
	1	.95			1.0					
Time	2		.90			1.0				
2	3			.45			1.0			
	1	.95			.95			1.0		
Time	2		.78			.75			1.0	
3	3			.49			.61			1.0

If Red and White are 10 galileos apart, how far apart are:

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	ID #	1-5
	Wave #	6
	Card # 01	7-8
Over Population and The War	0102____Gal.	9--17
Over Population Public Transportation	0103____Gal.	18--26
Over Population and Capitalism	0104____Gal.	27--35
Over Population and The Most Serious National Problem	0105____Gal.	36--44
Over Population and Automobiles	0106____Gal.	45--53
Over Population and Air Pollution	0107____Gal.	54--62
Over Population and Socialism	0108____Gal.	63--71
Over Population and Noise Pollution	0109____Gal.	72--80

25

	Duplicate:	1-6
	Card # 02	7-8
Over Population and Environmental Protection	0110____Gal.	9--17
Over Population and Pesticides	0111____Gal.	18--26
Over Population and Crime	0112____Gal.	27--35
Over Population and Water Pollution	0103____Gal.	36--44
Over Population and Conservation	0114____Gal.	45--53
Over Population and Recycling Resources	0115____Gal.	54--62
The War and Public Transportation	0203____Gal.	63--71
The War and Capitalism	0204____Gal.	72--80

	Duplicate:	1-6
	Card # 03	7-8
The War and The Most Serious National Problem	0205____Gal.	9--17
The War and Automobiles	0206____Gal.	18--26
The War and Air Pollution	0207____Gal.	27--35
The War and Socialism	0208____Gal.	36--44
The War and Noise Pollution	0209____Gal.	45--53
The War and Environmental Protection	0210____Gal.	54--62
The War and Pesticides	0211____Gal.	63--71
The War and Crime	0212____Gal.	72--80

	Duplicate:	1-6
	Card # 04	7-8
The War and Water Pollution	0213____Gal.	9--17
The War and Conservation	0214____Gal.	18--26
The War and Recycling Resources	0215____Gal.	27--35
Public Transportation and Capitalism	0304____Gal.	36--44
Public Transportation and The Most Serious National Problem	0305____Gal.	45--53
Public Transportation and Automobiles	0306____Gal.	54--62
Public Transportation and Air Pollution	0307____Gal.	63--71
Public Transportation and Socialism	0308____Gal.	72--80

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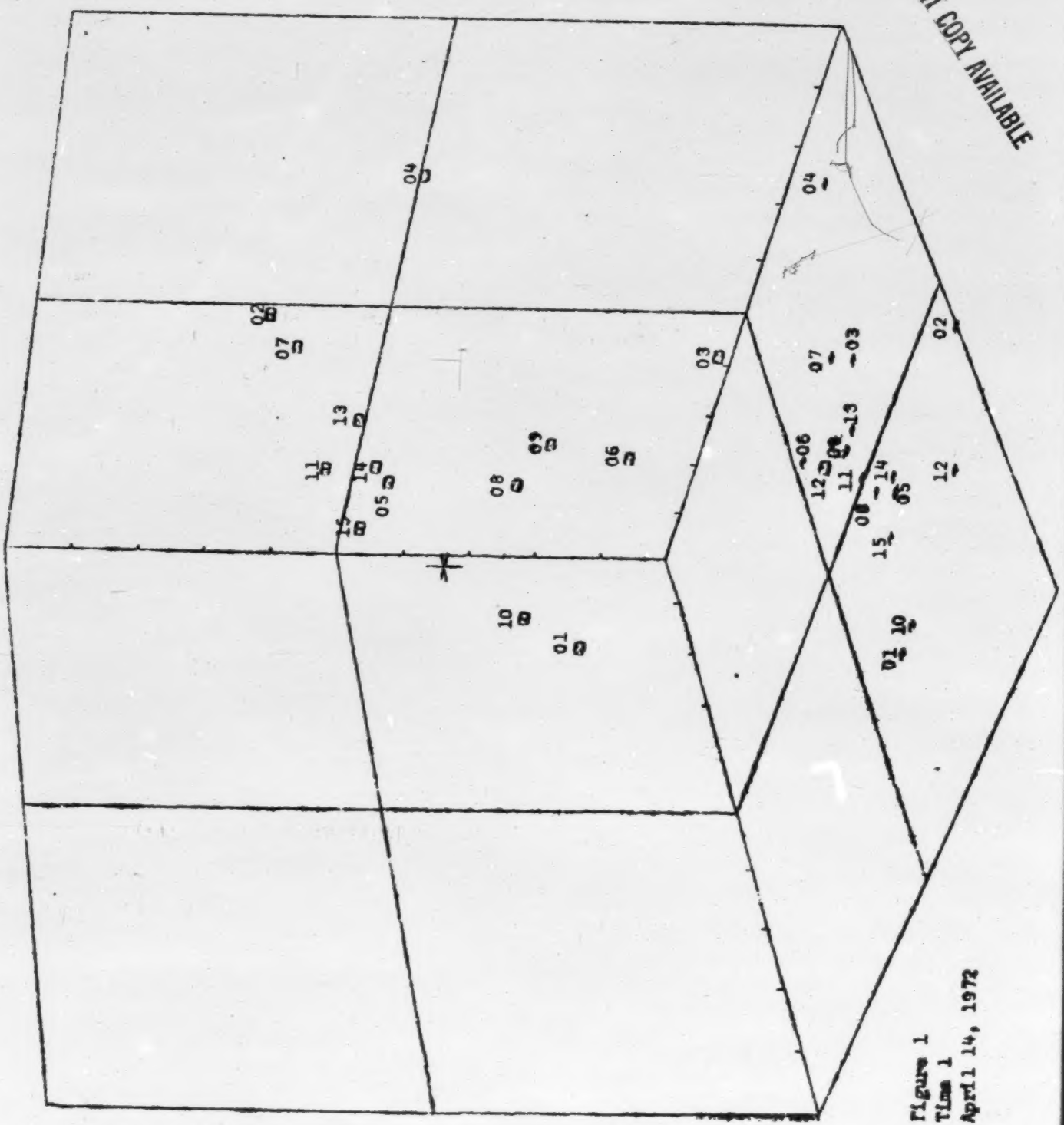

Figure 1
Time 1
April 14, 1972

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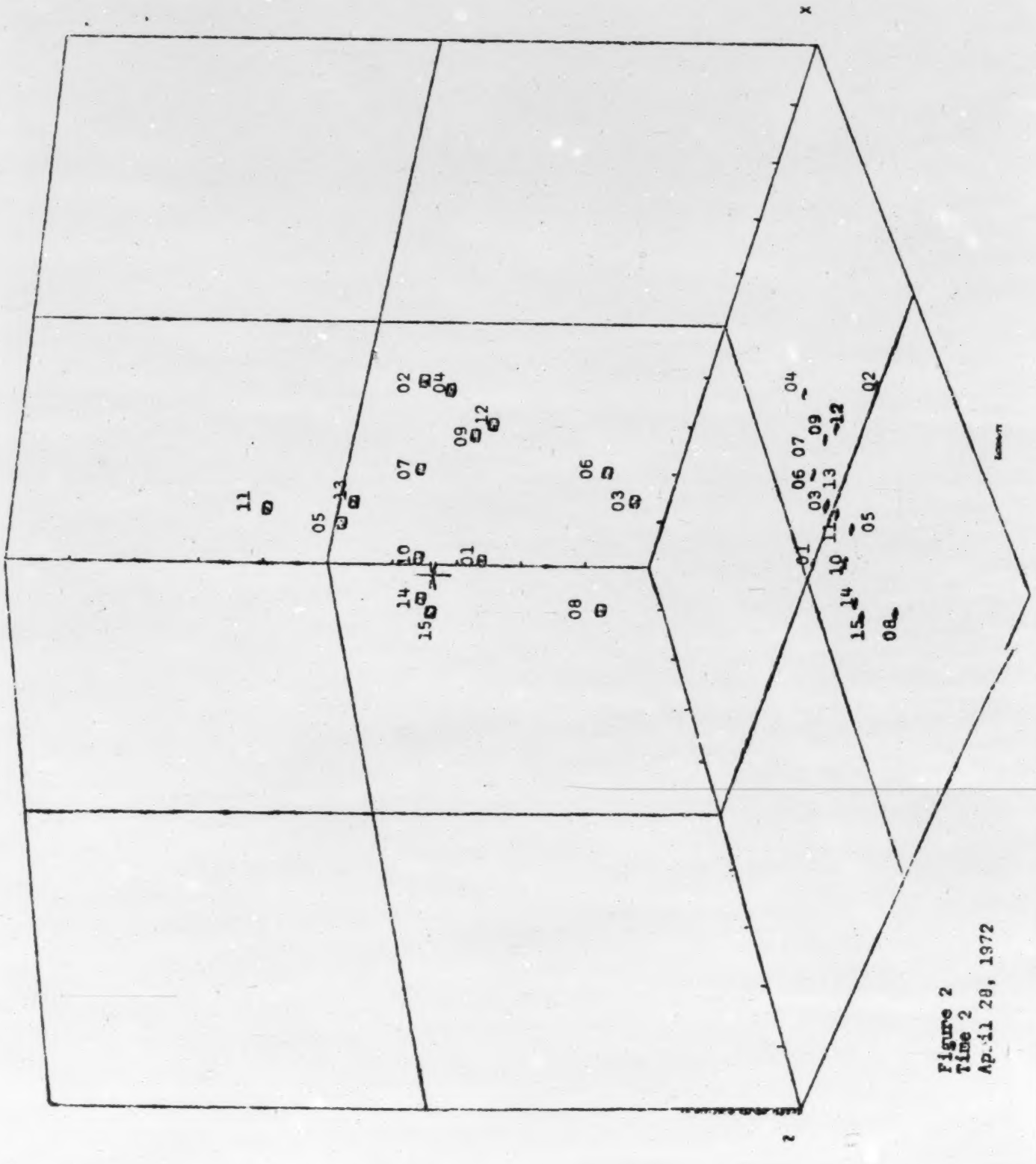

Figure 2
Time 2
April 28, 1972

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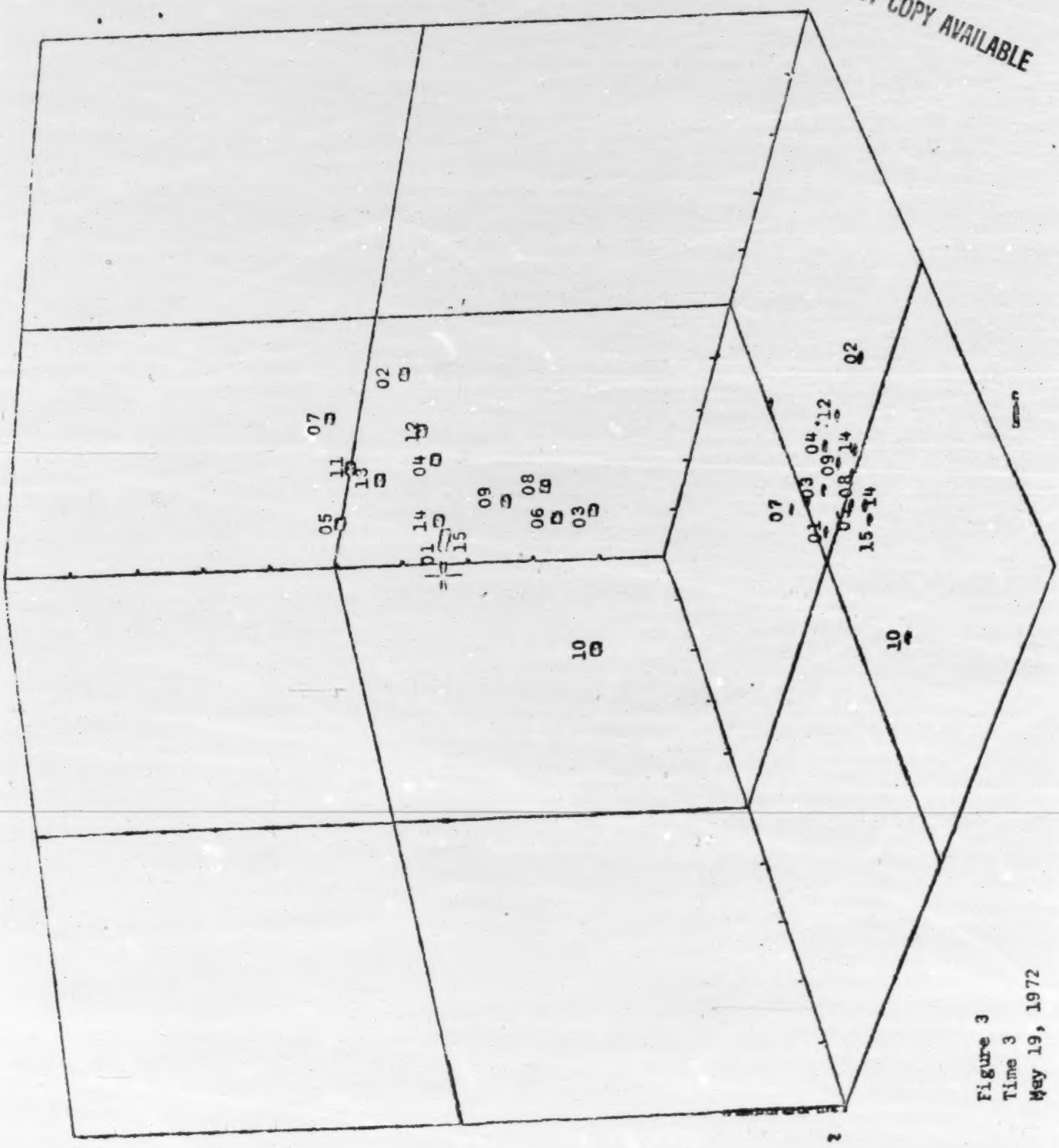

Figure 3
Time 3
May 19, 1972

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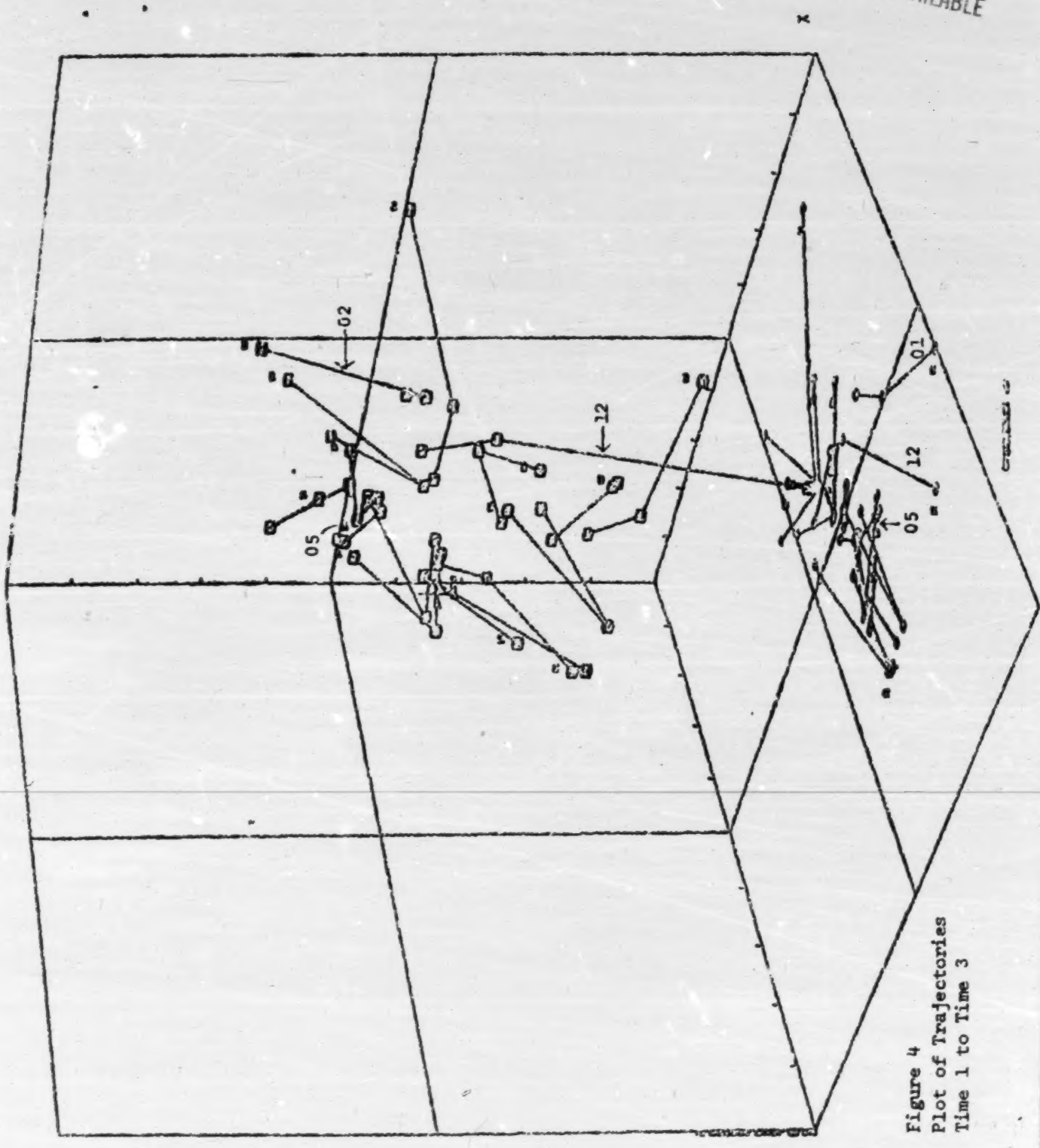

Figure 4
Plot of Trajectories
Time 1 to Time 3

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